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A STUDY OF SPOTTED OWL DEMOGRAPHICS IN THE SIERRA
NATIONAL FOREST AND SEQUOIA AND KINGS CANYON
NATIONAL PARKS

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ANNUAL PROGRESS REPORT
1993-1994

A STUDY OF SPOTTED OWL DEMOGRAPHICS IN THE SIERRA NATIONAL
FOREST AND SEQUOIA AND KINGS CANYON NATIONAL PARKS

by

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INTRODUCTION

This report summarizes key activities and preliminary results of demographic studies of spotted owls in the Sierra National Forest (SNF) and the Sequoia/Kings Canyon National Parks (SNP) for 1993 and 1994. The demographic studies were initiated in March of 1990 and will allow comparisons between spotted owl demographics in a managed National Forest and protected forests of the National Park. An additional study area (New Sierra (NS)) was initiated adjacent to the SNF to provide complete coverage of the Kings River Ecological Management area. Results from NS are also provided in this report. All tables and figures have been updated to reflect the current analysis of data for all years (1990-1994). This report supersedes all previous annual reports.

OBJECTIVES

1. Estimate densities of spotted owls and occupancy status of owl territories in the designated study areas.
2. Estimate vital rates (reproduction, mortality), by age class.
3. Assess site fidelity among individual spotted owls.
4. Estimate turnover rates (reoccupation of territories vacated during the study).
5. Quantify the distribution of vegetative habitats within the study areas.
6. Characterize diets of spotted owls from regurgitated pellets, and compare diets of breeding and nonbreeding pairs during the breeding period (1 March to 30 September).

STUDY AREA

Boundaries of study areas were delineated on major topographic features such as ridges, drainages (major rivers), and administrative boundaries (eg. Sequoia and Kings Canyon National Parks boundaries). The SNF study area covers 161 mi², NS study area covers 103 mi² and the SNP study area covers 130 mi² (Fig. 1). Three vegetative types, oak woodland (1,000 to 4,000 feet), mid-elevation coniferous forest (4,000 to 8,000 feet) and high elevation coniferous forest (8,000 to 9,600 feet) are found in all study areas. A detailed description of these vegetation types and the area they occupy for the SNF and SNP can be found in the 1990 annual report (Verney et al. 1990). For the NS study site the oak-woodland type encompasses 11 mi² (28 km²) vegetation description is the same as SNF. The mid-elevation coniferous forest occupies 69 mi² (179 km²) with the same vegetation as SNF. The high-elevation coniferous forest covers 23 mi² (60 km²) and has the same vegetative description as SNF.

METHODS

We attempted to locate, capture and color band all spotted owls within all study areas. Spotted owls were located by night and day calling surveys using vocal imitations of spotted owls to elicit responses. The methods of survey included point surveys, leap frog road surveys, and walking cruise surveys.

The protocol for surveying, determining social status, nesting status and reproductive status can be found in Verner et al. (1990). In general, regardless of study area or year, we attempted to apply equal survey effort. Conditions that may have influenced survey effort were inclement weather conditions, such as high winds or steady rain, and water noise when surveying drainages.

RESULTS

SURVEY

Calling surveys for 1993 and 1994 began in all study areas in the first week of March and ended on 30 September. All study areas were divided in smaller subdivision or sites and then an attempt was made to survey all sites within the study areas six times regardless of vegetation type, slope, aspect, or elevation. Total coverage (six full surveys in all sites) remained incomplete for all study areas in both 1993 and 1994. In 1994 in SNF and NS the majority of area called less than six times was above 8,000 ft (2,438 m). On the SNP, 33 sites were occupied by pairs (1 site was occupied by 2 pairs), 26 sites received 6 complete surveys without the detection of resident pairs, and 2 sites were used by pairs nesting in neighboring sites. The 8 remaining sites were not completely surveyed due to access problems.

DETECTION AND CAPTURE

A summary of the social status of owls in the SNF is reported in table 1a, and sex and age class distributions are reported in table 2a. Adult and subadult numbers increased by eight in 1993 and four in 1994, and the number of juveniles produced dropped slightly from 23 in 1993 to 20 in 1994. For the five years of the study the SNF has averaged 31.4 pairs of owls per year producing an average of 25 juveniles per year, or 0.796 juveniles per pair per year. In 1993, 17 adults and subadults (10 males and 7 females) were captured. In 1994, 13 adults and subadults (8 males and 5 females) were captured, bringing the total adult and subadult captures to 110. In 1993 27.8% of the nonjuvenile males that were identified to age class were subadults. The average from the preceeding 3 years was 15.2%. The percentage of subadults increased again in 1994 to 40.5%. From 1990 to 1992 the average of nonjuvenile females identified to age class that were subadults was 4.8%. In 1993 and 1994, respectively, 9.1% and 15.2% of females identified to age class were subadults. All juveniles that were known to be produced in the study area in 1993 and 1994 were banded. One hundred and fourteen juveniles have been banded on the SNF study area to date. Of the 94 juveniles banded prior to 1994, 14 have been recaptured, two from 1990, none from 1991, nine from 1992, and three from 1993. Four other juveniles, three banded in 1992, and one banded in 1993, have been seen in the study area but remain uncaptured. Sex ratio of returned juveniles is 11/3 (male/female).

A summary of the social status of owls in the SNP is reported in table 1b, and sex and age class distributions are reported in table 2b. The number of adults and subadults increased from the 60 found in 1992 to 67 in 1993 and 75 in 1994. Fifteen and 22 juveniles were fledged in 1993 and 1994,

respectively. The 5 year average of the number of juveniles fledging per year is 20.4 from an average of 26.8 pairs of owls, or 0.761 juveniles per pair per year. In 1993, seven adults and subadults (4 males and 3 females) were banded, and in 1994, 16 (4 males and 12 females) were banded. (This includes one female caught in February 1994 that was not detected on the study area during the protocol survey period.) Ninety-four adults and subadults have been banded on the SNP study area to date. In 1993 under 7% of the nonjuvenile males that were identified to age class were subadults. This is similar to the average from the 3 preceeding years in which subadults were 6.25% of these males. The number of subadult males detected in 1994 increased six-fold over any of the previous years, accounting for over 35% of the nonjuvenile males that were identified to age class. In 1993 and 1994, 10.7% and 12.5%, respectively, of the nonjuvenile females that were identified to age class were subadults. This is similar to the average from the preceeding 3 years in which subadults were 10.0% of these females. Twelve of 15 juveniles were captured and banded in 1993 and 21 of 22 juveniles were captured in 1994. Eighty-five juveniles have been banded on the SNP study area to date, including one each from 1993 and 1994 that died before dispersing from its natal area. In 1993 one adult male banded as a juvenile in 1990 and one subadult female with a 1992 juvenile band were observed, but neither owl was recaptured. A dead subadult male with a 1992 juvenile band was recovered after the protocol period in 1993. In 1994, eight subadults (4 fledged in 1992, 4 in 1993) and one adult (fledged in 1990) were seen with juvenile bands. Seven of the subadults (3 fledged in 1992, 4 fledged in 1993) and the adult were recaptured. Sex ratio of returned juveniles is 8/2 (male/female).

In NS study site, 37 adult and subadult owls were detected, 28 were captured and banded, with an adult/subadult ratio of 80% to 20% (tables 1c and 2c). Two previously banded owls were found in the new study area, a juvenile banded in 1989 on the SNF and a 1992 juvenile banded in SNP. Eleven juveniles were detected and all were banded.

DENSITY

Spotted owl density estimates for all study areas are reported in table 3. Both SNF and SNP study areas have had a steady increase in the density of owls with the greatest increases occurring in the SNP during the 1993 and 1994 seasons. Crude density for the SNF and SNP averaged 0.485 and 0.486 birds per square mile, respectively, for the five years of the study.

MISSING, REPLACED AND MOVEMENT

Turnover events included only banded owls that were missing, replaced, or moved from one site to another from the previous year. Data for the SNF are reported in table 4a (1990-1991), table 4b (1991-1992), table 4c (1992-1993), and table 4d (1993-1994). For 1990-1991 there were 33 banded owls with confirmed status (either present or a turnover event). Twenty-seven owls were present, six owls were confirmed missing and replaced and two moved to new sites with one of the moved birds being replaced. In 1991-1992 there were 41 banded owls with confirmed status, 35 present, six missing of which six were replaced, and five movements. In 1992-1993 there were 58 banded owls with

confirmed status, 50 present, eight missing of which eight were replaced, and no movements. In 1993-1994 there were 64 banded owls with confirmed status, 50 present, 14 missing of which 11 were replaced, and two movements. The empirical relocation rate, or the number of banded owls relocated each year from previous year was 82% for 1991, 85% for 1992, 86% for 1993, and 78% for 1994 (Tables 5a, 5b, 5c, and 5d). The average relocation rate for the time period of 1990 - 1994 was 82.8%.

Missing, replaced, and movement data for the SNP are reported in table 6a (1990-1991), table 6b (1991-1992), table 6c (1992-1993), and table 6d (1993-1994). In 1990-1991 there were 22 banded owls with confirmed status. Eighteen owls were present, four were missing, three were replaced, and one moved. In 1991-1992 there were 29 banded owls with confirmed status. Twenty-four were present, five were missing, five were replaced, and two moved. In 1992-1993 there were 49 banded owls with confirmed status, of which 46 were present, three were missing, three were replaced, and none moved. In 1993-1994 there were 55 banded owls with confirmed status. Forty-six were present, nine were missing, nine were replaced, and three moved. The empirical relocation rate was 94% for 1993 and 84% for 1994 (Tables 7a and 7b) and averaged 85.8% for the time period of 1990 - 1994.

REPRODUCTION AND NESTING ATTEMPTS

The proportion of owl pairs nesting on the SNF, as determined by protocol, was 58% for both 1993 and 1994 (Table 8a) with a five year average of 67%. The proportion of owls checked for reproduction by July 15, which fledged young, was 42% for both 1993 and 1994 (Table 9a) and the number of young fledged per pair that was checked for reproduction was 0.70 in 1993 and 0.61 in 1994 (Table 10a). The average number of young fledged per successful reproductive pair was 1.64 in 1993 and 1.43 in 1994 (Table 11a). The five year average of young fledged per successful pair on the SNF is 1.59. The fecundity rate for the SNF was 0.484 (fecundity = the expected number of female fledglings produced per female per year, assuming a 50:50 sex ratio in juvenile spotted owls).

In the SNP the proportion of owl pairs nesting as determined by protocol was 60% for 1993 and 59% for 1994 (Table 8b), and the five year average was 61%. The proportion of owls checked for reproduction by July 15 that fledged young was 44% for 1993 and 48% for 1994 (Table 9b) and the mean number of young fledged per pair checked for reproduction was 0.60 for 1993 and 0.76 for 1994 (Table 10b). The average number of young fledged per successful reproductive pair was 1.36 for 1993 and 1.57 for 1994 (Table 11b). The five year average of young fledged per successful pair on the SNP is 1.50. The fecundity rate for the SNP was 0.460 (fecundity = the expected number of female fledglings produced per female per year, assuming a 50:50 sex ratio in juvenile spotted owls).

DISCUSSION

Findings of particular interest were the low proportion of fledged young in both study areas in 1991, then the high proportion found in 1992. The cause of the low reproductive rates are unknown at this time, although both study areas did receive heavy rainfall in March, 1991 at the time of egg laying and nesting. The cause of the high reproductive rate in 1992 is also unknown, but it may relate to the 1991 rainfall patterns. Other findings of interest include the increase in the number of adult and subadult owls detected from 1991 through 1994 on the SNF and 1990 through 1994 on the SNP study area. In the SNP an additional 21 owls were detected in 1994 than in 1990. The largest increase between consecutive years was from 1993 to 1994, where the number of owls detected rose by 8. The smallest change in owl detections between consecutive years was from 1991 to 1992 when the number of owls remained constant at sixty. Part of the increase in number of owls detected can probably be attributed to an increase in survey effort and efficiency. This is especially true when comparing the number of owls detected in other years to the 54 owls detected in 1990, when field crew size was the smallest and the field season was the shortest. But these factors do not account for all of the of 21 owl increase over the 5 years. There has been a real increase in the number of owls detected on the SNP study area from the early 1990's to the mid 1990's. Part of the increase may be explained by the large number of juveniles produced in 1992 and the entrance of those owls into the resident population. Both the SNF and SNP had increases in subadult males in 1994, the majority of those having fledged in 1992.

In SNP, 1993 and 1994 were the only years that owls with juvenile bands have been recovered/recaptured. The 19/5 ratio of males to females for recaptured owls with juvenile bands with in all study sites is also noteworthy. One owl banded as a juvenile in SNP was recaptured on the NS study area. This is the first documented movement of owls between SNP and the other study areas.

LITERATURE CITED

- Verner, Jared, G. N. Steger, G. P. Eberlein D. A. Leal, and T. E. Munton. 1991. Part 1: Spotted Owl home-range size and composition in the Sierra National Forest. Part 2: Demography of spotted owls in the Sierra National Forest and Sequoia/Kings Canyon National Parks. Annual Progress Report 1990. Internal Report, Pacific Southwest Forest and Range Experiment Station, Fresno, California. 9 pp.

TABLE 1a. Summary of social status of California spotted owls on the Sierra National Forest, 1990 - 1994.

SOCIAL STATUS	1990	1991	1992	1993	1994
ADULT AND SUBADULT					
PAIR	31	27	32	33	34
SINGLE MALE	0	2	1	4	4
SINGLE FEMALE	0	0	1	1	0
MALE & FEMALE PRESENT	5	0	1	1	1
MALE PRESENT	9	10	1	4	8
FEMALE PRESENT	4	3	3	2	0
UNKNOWN				1	2
TOTAL NUMBER OF OWLS	85	69	72	80	84
JUVENILES	22	7 (6+1)	53 (52+1)	23	20

TABLE 1b. Summary of social status of California spotted owls on the Sequoia Kings Canyon National Parks, 1990 - 1994.

SOCIAL STATUS	1990	1991	1992	1993	1994
ADULT AND SUBADULT					
PAIR	22	23	27	28	34
SINGLE MALE	0	0	0	0	0
SINGLE FEMALE	0	1	0	0	0
MALE & FEMALE PRESENT	2	5	0	2	0
MALE PRESENT	5	1	5	4	4
FEMALE PRESENT	1	0	0	2	2
UNKNOWN PRESENT	0	2	1	1	0
FEMALE REPLACED					1
TOTAL NUMBER OF OWLS	54	60	60	67	75
JUVENILES	21 (12+9)	1	43	15	22

TABLE 1c. Summary of social status of California spotted owls on the New Sierra Study Area 1994.

SOCIAL STATUS	1994
ADULT AND SUBADULT	
PAIR	15
SINGLE MALE	0
SINGLE FEMALE	1
MALE & FEMALE PRESENT	0
MALE PRESENT	3
FEMALE PRESENT	2
UNKNOWN PRESENT	1
FEMALE REPLACED	0
TOTAL NUMBER OF OWLS	37
JUVENILES	11 (9+2)

Table 2a. Sex and age class distribution of California spotted owls identified to age class on the Sierra National Forest, 1990 - 1994.

Sex	Age Class	1990		1991		1992		1993		1994	
		N	%	N	%	N	%	N	%	N	%
Male	Adult	25	80.7	24	80.0	27	87.1	26	72.2	22	59.5
	Subadult	6	19.3	6	20.0	4	12.9	10	27.8	15	40.5
	Combined	31	100.0	30	100.0	31	100.0	36	100.0	37	100.0
Female	Adult	22	88.0	28	100.0	30	96.7	30	90.9	28	84.9
	Subadult	3	12.0	0	0.0	1	3.3	3	9.1	5	15.1
	Combined	25	100.0	28	100.0	31	100.0	33	100.0	33	100.0
Both	Adult	47	83.9	52	89.7	57	91.9	56	81.2	50	71.4
	Subadult	9	16.1	6	10.3	5	8.1	13	18.8	20	28.6
	Combined	56	100.0	58	100.0	62	100.0	69	100.0	70	100.0

Table 2b. Sex and age class distribution of California spotted owls identified to age class on the Sequoia Kings Canyon National Parks, 1990 - 1994.

Sex	Age Class	1990		1991		1992		1993		1994	
		N	%	N	%	N	%	N	%	N	%
Male	Adult	16	94.1	19	90.5	25	96.2	27	93.1	22	64.7
	Subadult	1	5.9	2	9.5	1	3.8	2	6.9	12	35.3
	Combined	17	100.0	21	100.0	26	100.0	29	100.0	34	100.0
Female	Adult	11	84.6	18	85.7	25	96.2	25	89.3	28	87.5
	Subadult	2	15.4	3	14.3	1	3.8	3	10.7	4	12.5
	Combined	13	100.0	21	100.0	26	100.0	28	100.0	32	100.0
Both	Adult	27	90.0	37	88.1	50	96.2	52	91.2	50	75.8
	Subadult	3	10.0	5	11.9	2	3.8	5	8.8	16	24.2
	Combined	30	100.0	42	100.0	52	100.0	57	100.0	66	100.0

Table 2c. Sex and age class distribution of California spotted owls identified to age class on the New Sierra Study Site, 1994 -

Sex	Age Class	1994		1995		1996		1997		1998	
		N	%	N	%	N	%	N	%	N	%
Male	Adult	11	84.6								
	Subadult	2	15.4								
	Combined	13	100.0								
Female	Adult	9	75.0								
	Subadult	3	25.0								
	Combined	12	100.0								
Both	Adult	20	80.0								
	Subadult	5	20.0								
	Combined	25	100.0								

TABLE 3.

CRUDE DENSITY

Mean crude density estimates (n per mi²) for California Spotted Owls on the Sierra National Forest and Sequoia and Kings Canyon National Parks Study Areas, from 1990 through 1994. Crude density was calculated by dividing the number of owls detected by the number of square miles in each study area.

SIERRA STUDY AREA

YEAR	TOTAL AREA	OWLS DETECTED	CRUDE DENSITY
1990	160.4	85	0.530
1991	160.4	69	0.430
1992	160.4	72	0.449
1993	160.4	80	0.499
1994	160.4	84	0.524

SEQUOIA/KINGS STUDY AREA

1990	130.0	54	0.415
1991	130.0	60	0.462
1992	130.0	60	0.462
1993	130.0	67	0.515
1994	130.0	75	0.577

NEW SIERRA STUDY SITE

1994	103	37	0.359
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TABLE 4a. Missing, replaced and inter-site movement rates for only banded California spotted owls on the Sierra National Forest between 1990 and 1991.

Sex	Age Class	No. Banded 1990	MISSING		REPLACED		MOVEMENT	
			N	%	N	%	N	%
Male	Adult	15	3	0.20	4	0.27	1	0.07
	Subadult	5	2	0.40	2	0.40	0	0.00
	Unknown	<u>0</u>	<u>0</u>	<u>0.00</u>	<u>0</u>	<u>0.00</u>	<u>0</u>	<u>0.00</u>
	Total	20	5	0.25	6	0.30	1	0.05
Female	Adult	12	1	0.08	1	0.08	1	0.08
	Subadult	1	0	0.00	0	0.00	0	0.00
	Unknown	<u>0</u>	<u>0</u>	<u>0.00</u>	<u>0</u>	<u>0.00</u>	<u>0</u>	<u>0.00</u>
	Total	13	1	0.08	1	0.08	1	0.08
Both	Adult	27	4	0.15	5	0.19	2	0.07
	Subadult	6	2	0.33	2	0.33	0	0.00
	Unknown	<u>0</u>	<u>0</u>	<u>0.00</u>	<u>0</u>	<u>0.00</u>	<u>0</u>	<u>0.00</u>
	Combined	33	6	0.18	7	0.21	2	0.06

TABLE 4b. Missing, replaced and inter-site movement rates for only banded California spotted owls on the Sierra National Forest between 1991 and 1992.

Sex	Age Class	No. Banded 1991	MISSING		REPLACED		MOVEMENT	
			N	%	N	%	N	%
Male	Adult	17	2	0.12	2	0.12	1	0.06
	Subadult	5	1	0.20	1	0.20	2	0.40
	Unknown	<u>0</u>	<u>0</u>	<u>0.00</u>	<u>0</u>	<u>0.00</u>	<u>0</u>	<u>0.00</u>
	Total	22	3	0.14	3	0.14	3	0.14
Female	Adult	19	3	0.16	3	0.16	2	0.11
	Subadult	0	0	0.00	0	0.00	0	0.00
	Unknown	<u>0</u>	<u>0</u>	<u>0.00</u>	<u>0</u>	<u>0.00</u>	<u>0</u>	<u>0.00</u>
	Combined	19	3	0.16	3	0.16	2	0.11
Both	Adult	36	5	0.14	5	0.14	3	0.08
	Subadult	5	1	0.20	1	0.20	2	0.40
	Unknown	<u>0</u>	<u>0</u>	<u>0.00</u>	<u>0</u>	<u>0.00</u>	<u>0</u>	<u>0.00</u>
	Combined	41	6	0.15	6	0.15	5	0.12

TABLE 4c. Missing, replaced and inter-site movement rates for only banded California spotted owls on the Sierra National Forest between 1992 and 1993.

Sex	Age Class	No. Banded 1992	MISSING		REPLACED		MOVEMENT	
			N	%	N	%	N	%
Male	Adult	26	5	0.19	5	0.19	0	0.00
	Subadult	4	1	0.25	1	0.25	0	0.00
	Unknown	<u>0</u>	<u>0</u>	<u>0.00</u>	<u>0</u>	<u>0.00</u>	<u>0</u>	<u>0.00</u>
	Total	30	6	0.20	6	0.20	0	0.00
Female	Adult	26	2	0.08	2	0.08	0	0.00
	Subadult	1	0	0.00	0	0.00	0	0.00
	Unknown	<u>1</u>	<u>0</u>	<u>0.00</u>	<u>0</u>	<u>0.00</u>	<u>0</u>	<u>0.00</u>
	Combined	28	2	0.07	2	0.07	0	0.00
Both	Adult	52	7	0.13	7	0.13	0	0.00
	Subadult	5	1	0.20	1	0.20	0	0.00
	Unknown	<u>1</u>	<u>0</u>	<u>0.00</u>	<u>0</u>	<u>0.00</u>	<u>0</u>	<u>0.00</u>
	Combined	58	8	0.14	8	0.14	0	0.00

TABLE 4D. Missing, replaced and inter-site movement rates for only banded California spotted owls on the Sierra National Forest between 1993 and 1994.

Sex	Age Class	No. Banded 1993	MISSING		REPLACED		MOVEMENT	
			N	%	N	%	N	%
Male	Adult	22	7	0.32	6	0.27	0	0.00
	Subadult	7	2	0.29	1	0.14	1	0.14
	Unknown	<u>2</u>	<u>0</u>	<u>0.00</u>	<u>0</u>	<u>0.00</u>	<u>0</u>	<u>0.00</u>
	Total	31	9	0.29	7	0.23	1	0.03
Female	Adult	29	5	0.17	4	0.14	1	0.03
	Subadult	2	0	0.00	0	0.00	0	0.00
	Unknown	<u>2</u>	<u>0</u>	<u>0.00</u>	<u>0</u>	<u>0.00</u>	<u>0</u>	<u>0.00</u>
	Combined	33	5	0.15	4	0.12	1	0.03
Both	Adult	51	12	0.24	10	0.20	1	0.02
	Subadult	9	2	0.22	1	0.11	1	0.11
	Unknown	<u>4</u>	<u>0</u>	<u>0.00</u>	<u>0</u>	<u>0.00</u>	<u>0</u>	<u>0.00</u>
	Combined	64	14	0.22	11	0.17	2	0.03

TABLE 5a. Empirical relocation rates of banded California spotted owls on the Sierra National Forest between 1990 and 1991.

Sex	Age Class	No. Banded 1990	RELOCATED	
			N	Percent
Male	Adult	15	12	0.80
	Subadult	5	3	0.60
	Unknown			
	Total	20	15	0.75
Female	Adult	12	11	0.92
	Subadult	1	1	1.00
	Unknown			
	Total	13	12	0.92
Both	Adult	27	23	0.85
	Subadult	6	4	0.67
	Unknown			
	Combined	33	27	0.82

TABLE 5b. Empirical relocation rates of banded California spotted owls on the Sierra National Forest between 1991 and 1992.

Sex	Age Class	No. Banded 1991	RELOCATED	
			N	Percent
Male	Adult	17	15	0.88
	Subadult	5	4	0.80
	Unknown			
	Total	22	19	0.86
Female	Adult	19	16	0.84
	Subadult	0	0	0.00
	Unknown			
	Total	19	16	0.84
Both	Adult	36	31	0.86
	Subadult	5	4	0.80
	Unknown			
	Combined	41	35	0.85

TABLE 5c. Empirical relocation rates of banded California spotted owls on the Sierra National Forest between 1992 and 1993.

Sex	Age Class	No. Banded 1992	RELOCATED	
			N	Percent
Male	Adult	26	21	0.81
	Subadult	4	3	0.75
	Unknown			
	Total	30	24	0.80
Female	Adult	26	24	0.92
	Subadult	1	1	1.00
	Unknown	1	1	1.00
	Total	28	26	0.93
Both	Adult	52	45	0.87
	Subadult	5	4	0.80
	Unknown	1	1	1.00
	Combined	58	50	0.86

TABLE 5D. Empirical relocation rates of banded California spotted owls on the Sierra National Forest between 1993 and 1994.

Sex	Age Class	No. Banded 1993	RELOCATED	
			N	Percent
Male	Adult	22	15	0.68
	Subadult	7	5	0.71
	Unknown	2	2	1.00
	Total	31	22	0.71
Female	Adult	29	24	0.83
	Subadult	2	2	1.00
	Unknown	2	2	1.00
	Total	33	28	0.85
Both	Adult	51	39	0.76
	Subadult	9	7	0.78
	Unknown	4	4	1.00
	Combined	64	50	0.78

TABLE 6a. Missing, replaced and inter-site movement rates for banded California spotted owls on the Sequoia Kings Canyon National Parks between 1990 and 1991.

Sex	Age Class	No. Banded	MISSING		REPLACED		MOVEMENT	
		1990	N	%	N	%	N	%
Male	Adult	9	1	0.11	1	0.11	0	0.00
	Subadult	1	0	0.00	0	0.00	1	1.00
	<u>Unknown</u>	<u>1</u>	<u>0</u>	<u>0.00</u>	<u>0</u>	<u>0.00</u>	<u>0</u>	<u>0.00</u>
	Combined	11	1	0.09	1	0.09	1	0.09
Female	Adult	7	2	0.29	1	0.14	0	0.00
	Subadult	1	0	0.00	0	0.00	0	0.00
	<u>Unknown</u>	<u>3</u>	<u>1</u>	<u>0.33</u>	<u>1</u>	<u>0.33</u>	<u>0</u>	<u>0.00</u>
	Combined	11	3	0.27	2	0.18	0	0.00
Both	Adult	16	3	0.19	2	0.13	0	0.00
	Subadult	2	0	0.00	0	0.00	1	0.50
	<u>Unknown</u>	<u>4</u>	<u>1</u>	<u>0.25</u>	<u>1</u>	<u>0.25</u>	<u>0</u>	<u>0.00</u>
	Combined	22	4	0.18	3	0.14	1	0.05

TABLE 6b. Missing, replaced and inter-site movement rates for banded California spotted owls on the Sequoia Kings Canyon National Parks between 1991 and 1992.

Sex	Age Class	No. Banded	MISSING		REPLACED		MOVEMENT	
		1991	N	%	N	%	N	%
Male	Adult	11	3	0.27	2	0.18	0	0.00
	Subadult	1	0	0.00	0	0.00	0	0.00
	<u>Unknown</u>	<u>3</u>	<u>0</u>	<u>0.00</u>	<u>0</u>	<u>0.00</u>	<u>0</u>	<u>0.00</u>
	Combined	15	3	0.20	2	0.13	0	0.00
Female	Adult	11	2	0.18	3	0.27	1	0.09
	Subadult	2	0	0.00	0	0.00	1	0.50
	<u>Unknown</u>	<u>1</u>	<u>0</u>	<u>0.00</u>	<u>0</u>	<u>0.00</u>	<u>0</u>	<u>0.00</u>
	Combined	14	2	0.14	3	0.21	2	0.14
Both	Adult	22	5	0.23	5	0.23	1	0.05
	Subadult	3	0	0.00	0	0.00	1	0.33
	<u>Unknown</u>	<u>4</u>	<u>0</u>	<u>0.00</u>	<u>0</u>	<u>0.00</u>	<u>0</u>	<u>0.00</u>
	Combined	29	5	0.17	5	0.17	2	0.07

TABLE 6c. Missing, replaced and inter-site movement rates for banded California spotted owls on the Sequoia Kings Canyon National Parks between 1992 and 1993.

Sex	Age Class	No. Banded 1992	MISSING		REPLACED		MOVEMENT	
			N	%	N	%	N	%
Male	Adult	24	0	0.00	0	0.00	0	0.00
	Subadult	0	0	0.00	0	0.00	0	0.00
	<u>Unknown</u>	<u>0</u>	<u>0</u>	<u>0.00</u>	<u>0</u>	<u>0.00</u>	<u>0</u>	<u>0.00</u>
	Combined	24	0	0.00	0	0.00	0	0.00
Female	Adult	23	3	0.13	3	0.13	0	0.00
	Subadult	1	0	0.00	0	0.00	0	0.00
	<u>Unknown</u>	<u>1</u>	<u>0</u>	<u>0.00</u>	<u>0</u>	<u>0.00</u>	<u>0</u>	<u>0.00</u>
	Combined	25	3	0.12	3	0.12	0	0.00
Both	Adult	47	3	0.06	3	0.06	0	0.00
	Subadult	1	0	0.00	0	0.00	0	0.00
	<u>Unknown</u>	<u>1</u>	<u>0</u>	<u>0.00</u>	<u>0</u>	<u>0.00</u>	<u>0</u>	<u>0.00</u>
	Combined	49	3	0.06	3	0.06	0	0.00

TABLE 6D. Missing, replaced and inter-site movement rates for banded California spotted owls on the Sequoia Kings Canyon National Parks between 1993 and 1994.

Sex	Age Class	No. Banded 1993	MISSING		REPLACED		MOVEMENT	
			N	%	N	%	N	%
Male	Adult	26	6	0.23	5	0.19	0	0.00
	Subadult	2	0	0.00	0	0.00	0	0.00
	<u>Unknown</u>	<u>1</u>	<u>0</u>	<u>0.00</u>	<u>0</u>	<u>0.00</u>	<u>1</u>	<u>1.00</u>
	Combined	29	6	0.21	5	0.17	1	0.03
Female	Adult	23	3	0.13	2	0.09	0	0.00
	Subadult	2	0	0.00	1	0.50	1	0.50
	<u>Unknown</u>	<u>1</u>	<u>0</u>	<u>0.00</u>	<u>1</u>	<u>1.00</u>	<u>1</u>	<u>1.00</u>
	Combined	26	3	0.12	4	0.15	2	0.08
Both	Adult	49	9	0.18	7	0.14	0	0.00
	Subadult	4	0	0.00	1	0.25	1	0.25
	<u>Unknown</u>	<u>2</u>	<u>0</u>	<u>0.00</u>	<u>1</u>	<u>0.50</u>	<u>2</u>	<u>1.00</u>
	Combined	55	9	0.16	9	0.16	3	0.05

TABLE 7a. Empirical relocation rates of California spotted owls on the Sequoia Kings Canyon National Parks between 1990 and 1991.

Sex	Age Class	No. Banded 1990	RELOCATED	
			N	Percent
Male	Adult	9	8	0.89
	Subadult	1	1	1.00
	<u>Unknown</u>	<u>1</u>	<u>1</u>	<u>1.00</u>
	Combined	11	10	0.91
Female	Adult	7	5	0.71
	Subadult	1	1	1.00
	<u>Unknown</u>	<u>3</u>	<u>2</u>	<u>0.67</u>
	Combined	11	8	0.73
Both	Adult	16	13	0.81
	Subadult	2	2	1.00
	<u>Unknown</u>	<u>4</u>	<u>3</u>	<u>0.75</u>
	Combined	22	18	0.82

Two adult females which were identified in 1989 but not in 1990 were verified as replaced in 1991. They are not included in the above table.

This table includes an adult female that was missing (but not replaced) after a complete survey of its historic site.

Age=previous year

TABLE 7b. Empirical relocation rates of California spotted owls on the Sequoia Kings Canyon National Parks between 1991 and 1992.

Sex	Age Class	No. Banded 1991	RELOCATED	
			N	Percent
Male	Adult	11	8	0.73
	Subadult	1	1	1.00
	<u>Unknown</u>	<u>3</u>	<u>3</u>	<u>1.00</u>
	Combined	15	12	0.80
Female	Adult	11	9	0.82
	Subadult	2	2	1.00
	<u>Unknown</u>	<u>1</u>	<u>1</u>	<u>1.00</u>
	Combined	14	12	0.86
Both	Adult	22	17	0.77
	Subadult	3	3	1.00
	<u>Unknown</u>	<u>4</u>	<u>4</u>	<u>1.00</u>
	Combined	29	24	0.83

TABLE 7c. Empirical relocation rates of California spotted owls on the Sequoia Kings Canyon National Parks between 1992 and 1993.

Sex	Age Class	No. Banded 1992	RELOCATED	
			N	Percent
Male	Adult	24	24	1.00
	Subadult	0	0	0.00
	Unknown	0	0	0.00
	Combined	24	24	1.00
Female	Adult	23	20	0.87
	Subadult	1	1	1.00
	Unknown	1	1	1.00
	Combined	25	22	0.88
Both	Adult	47	44	0.94
	Subadult	1	1	1.00
	Unknown	1	1	1.00
	Combined	49	46	0.94

TABLE 7d. Empirical relocation rates of California spotted owls on the Sequoia Kings Canyon National Parks between 1993 and 1994.

Sex	Age Class	No. Banded 1993	RELOCATED	
			N	Percent
Male	Adult	26	20	0.77
	Subadult	2	2	1.00
	Unknown	1	1	1.00
	Combined	29	23	0.79
Female	Adult	23	20	0.87
	Subadult	2	2	1.00
	Unknown	1	1	1.00
	Combined	26	23	0.88
Both	Adult	49	40	0.82
	Subadult	4	4	1.00
	Unknown	2	2	1.00
	Combined	55	46	0.84

TABLE 8a. Proportion of California spotted owl pairs nesting on the Sierra National Forest, 1990 - 1994.

	<u>PAIRS CHECKED</u> <u>FOR NESTING</u>	<u>PAIRS NESTING</u>	<u>PROPORTION NESTING</u>
YEAR	N	N	Percent
1990	8	5	0.63
1991	9	6	0.67
1992	30	27	0.90
1993	33	19	0.58
1994	33	19	0.58

TABLE 8b. Proportion of California spotted owl pairs nesting on the Sequoia Kings Canyon National Parks, 1990 - 1994.

	<u>PAIRS CHECKED</u> <u>FOR NESTING</u>	<u>PAIRS NESTING</u>	<u>PROPORTION NESTING</u>
YEAR	N	N	Percent
1990	5	4	0.80
1991	11	2	0.18
1992	27	24	0.89
1993	25	15	0.60
1994	27	16	0.59

TABLE 8a. Proportion of California spotted owl pairs nesting on the New Sierra National Forest, 1990 - 1994.

	<u>PAIRS CHECKED</u> <u>FOR NESTING</u>	<u>PAIRS NESTING</u>	<u>PROPORTION NESTING</u>
YEAR	N	N	Percent
1994	11	6	0.55

TABLE 9a. Proportion of pairs of California spotted owls checked for reproduction by 15 July which fledged young on the Sierra National Forest, 1990 - 1994.

YEAR	No. Pairs Checked	No. Pairs Which Fledged Young	Proportion of All Pairs Checked Which Fledged Young
1990	18	13	0.72
1991	13	5	0.38
1992	30	26	0.87
1993	33	14	0.42
1994	33	14	0.42

TABLE 9b. Proportion of pairs of California spotted owls checked for reproduction by 15 July which fledged young on the Sequoia Kings Canyon National Parks, 1990 - 1994.

YEAR	No. Pairs Checked	No. Pairs Which Fledged Young	Proportion of All Pairs Checked Which Fledged Young
1990	8	7	0.88
1991	12	1	0.08
1992	27	23	0.85
1993	25	11	0.44
1994	29	14	0.48

TABLE 9c. Proportion of pairs of California spotted owls checked for reproduction by 15 July which fledged young on the New Sierra National Forest, 1990 - 1994.

YEAR	No. Pairs Checked	No. Pairs Which Fledged Young	Proportion of All Pairs Checked Which Fledged Young
1994	11	5	0.45

TABLE 10a. Mean number of young fledged per pair of California spotted owls checked for reproduction by 15 July on the Sierra National Forest, 1990 - 1994.

YEAR	No. Pairs Checked	Number of Young Found	Mean Number of Young Per Pair
1990	18	22	1.22
1991	13	6	0.46
1992	30	52	1.73
1993	33	23	0.70
1994	33	20	0.61

Table 10b. Mean number of young fledged per pair of California spotted owls checked for reproduction by 15 July on the Sequoia Kings Canyon National Parks, 1990 - 1994.

YEAR	No. Pairs Checked	Number of Young Found	Mean Number of Young Per Pair
1990	8	12	1.50
1991	12	1	0.08
1992	27	43	1.59
1993	25	15	0.60
1994	29	22	0.76

TABLE 10c. Mean number of young fledged per pair of California spotted owls checked for reproduction by 15 July on the New Sierra National Forest, 1990 - 1994.

YEAR	No. Pairs Checked	Number of Young Found	Mean Number of Young Per Pair
1994	11	9	0.81

TABLE 11a. Mean number of young fledged per pair of California spotted owls that fledged young on the Sierra National Forest, 1990 - 1994.

YEAR	No. Pairs Checked	No. Fledged Young	Mean Number of Young Fledged Per Pair
1990	13	22	1.69
1991	5	6	1.20
1992	26	52	2.00
1993	14	23	1.64
1994	14	20	1.43

TABLE 11a. Mean number of young fledged per pair of California spotted owls that fledged young on the Sequoia Kings Canyon National Parks, 1990 - 1994.

YEAR	No. Pairs Checked	No. Fledged Young	Mean Number of Young Fledged Per Pair
1990	7	12	1.71
1991	1	1	1.00
1992	23	43	1.87
1993	11	15	1.36
1994	14	22	1.57

TABLE 11c. Mean number of young fledged per pair of California spotted owls that fledged young on the New Sierra National Forest, 1990 - 1994.

YEAR	No. Pairs Checked	No. Fledged Young	Mean Number of Young Fledged Per Pair
1994	5	9	1.80